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**Bruno [IT/TT]; Via Pasquale, 7, I-40026 Imola (IT). SANTANDREA, Silver [IT/TT]; Via Mentana, 17, I-40026 Imola (IT).**

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(74) Agents: **PORSIA, Attilio et al.; Succ. Ing. Fischetti & Weber, Via Caffaro, 3/2, I-16124 Genova (IT).**

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(71) Applicant (*for all designated States except US*): **CEFLA SOC. COOP. A R.L. [IT/IT]; Via Selice Provinciale, 23/a, I-40026 Imola (IT).**

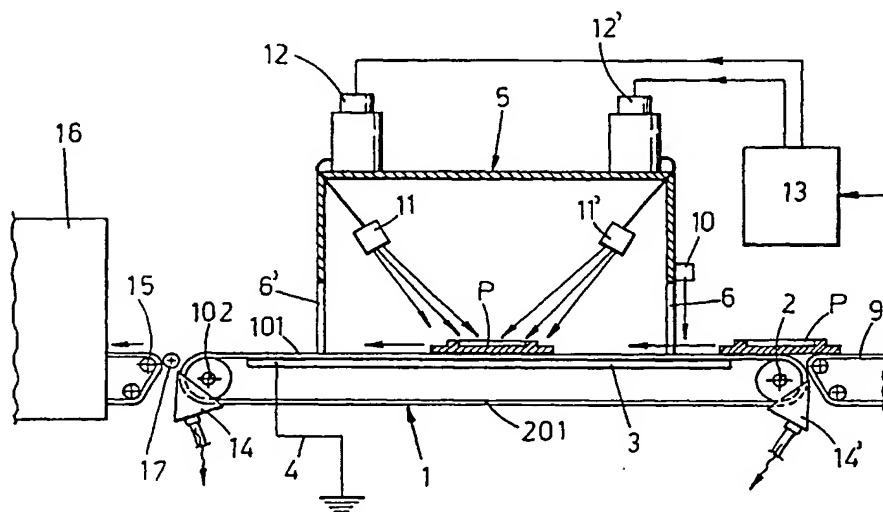
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(72) Inventors; and

(75) Inventors/Applicants (*for US only*): **BARONCINI,**

(54) Title: **METHOD AND APPARATUS FOR THE HORIZONTAL PAINTING OF WOOD PRODUCTS**



(57) Abstract: The wood products (P) to be painted are deposited on a horizontal and electrically conducting conveyor (1) which is connected to earth and which introduces the said products into a chamber (5) where spraying means (11, 11') operate, spraying a powdered paint which is electrostatically charged to a potential such as to be uniformly attracted by the visible surface of the said products. Means (14, 14') are provided for cleaning the lower section of the said conveyor, in order to collect and recycle the powdered paint which remains attached to the said conveyor. Finally, the painted products are transferred into an IR and/or UV-ray treatment oven (15, 16) for plasticization and hardening of the paint. Optional means (17) perform removal of any traces of powdered paint from the bottom side of the products, before the latter are introduced into the said oven (15, 16).

WO 01/85357 A1

TITLE: "Method and apparatus for the horizontal painting of wood products"

DESCRIPTION

Painting, on an industrial level, of wood products or wood by-products is  
5 currently performed mostly using liquid and solvent paints which, by means of guns,  
are sprayed onto the said products introduced into chambers kept under a slight  
vacuum with respect to the external environment so as to prevent the escape of the  
gaseous compounds contained in the paint products. According to the currently  
most widespread technique for industrial painting using liquid paints, the products  
10 are placed on a horizontal conveyor which introduces them into the painting chamber  
where only the visible surfaces of the said products are painted. If the products must  
be painted over their whole surface, the said products are passed through the  
painting chamber twice. According to a further painting technique, the products are  
hung vertically from conveying means so that they may be painted completely with a  
15 single pass through the painting chamber. Each of the said aforementioned  
techniques has advantages and defects. However, a common feature of both  
techniques is the difficulty and complexity of recovering the surplus paint material  
sprayed inside the chambers and not retained by the products as well as the  
problems associated with the use of a solvent and disposal of its gaseous  
20 compounds which are sucked in by the painting chamber and which are generally  
treated by disposal devices, including post-combustion systems.

The invention aims to overcome these and other drawbacks of the known art  
using the following proposed solution. For the industrial painting of mainly metal  
products it is currently known to use paints in the form of powders which are  
25 electrostatically charged and are sprayed in atomized form onto the products to be  
painted, usually hung from a conveying means, by means of which the said products  
are kept at an electric potential such as to attract the powdered paint which is thus  
able to cover uniformly the said products. After the said aforementioned painting  
step, the products pass into an oven which performs plasticization and hardening of  
30 the paint by the application of heat and/or, where necessary, ultraviolet radiation

which is particularly suitable when the products cannot fully withstand the first type of physical catalysis where relatively high temperatures are reached. This painting technique has the advantage that it does not use solvents and allows easy recovery by means of suction and easy recycling of the surplus powdered paint dispersed  
5 inside the painting chamber.

Powder painting was recently attempted with success on flat products of MDF (medium density fibreboard) which are vertically hung from a conveying system and are made superficially conductive beforehand by means of a cryogenic treatment or initial spraying of conductive liquids or introduction of conductive components into  
10 the conglomerate mass, prior to the pressing step, or by means of wetting of the support. After the step involving application of the powdered paint, the MDF products are passed into an oven for plasticization and hardening of the said paint by means of a heat treatment at 140°C and subsequent cooling. Similar experiments have also been attempted on flat wood products.

15 This technique is not applicable industrially within the sector of mainly flat wood products with small dimensions since:

- it would be necessary to provide holes on the products to be painted or parts which are fixed to the said products and would then have to be removed;
- the products would have to be loaded and unloaded manually onto and from  
20 overhead conveying means, resulting in a considerable increase in the production costs of small-size products;
- in the zone where connection to the overhead conveying means is performed, painting of the product would sometimes be imprecise and require touching-up or could result in production rejects.

25 The invention aims to overcome the drawbacks of the known art using a method and an apparatus which allow the advantages of traditional painting of wood products placed on a horizontal conveyor to be combined with the advantages of electrostatic painting. Wood products which have undergone a medium degree of seasoning have a tendency to charge electrostatically without the prior treatment  
30 required for MDF products. It is understood, however, that the wood products may, if

necessary, be subject to one of the said aforementioned prior treatments so that they can be made superficially electro-conductive. The products to be painted are deposited on the upper section of a conveyor which is made, for example, using a suitable electrically conductive elastomer resting on a metal surface kept at a suitable electric potential, for example connected to earth, so that the said products are at this same potential. The conveyor transports the products inside a painting chamber which is kept under a slight vacuum with respect to the external environment and inside which special means spray, onto the visible surface of the said products, a powdered paint charged electrostatically to a potential such that it may be attracted uniformly by the visible surface of the product and by the upper section of the conveyor. The paint used is preferably of the UV (ultraviolet) ray catalysis type. The painted products emerge from the painting chamber on the conveyor and are transferred from the said conveyor to a following conveying means which introduces them into the oven for plasticization and catalysis of the paint using preferably a combination of IR (infrared) radiation and UV radiation. The bottom surface of the product which leaves the painting unit conveyor is not soiled with paint since it is protected from physical contact or from coming into the immediate vicinity of the upper section of the said conveyor. If required, however, prior to transfer to the paint-plasticization and catalysis oven, a step involving cleaning of the bottom side of the products in order to remove any traces of powdered paint may be envisaged. Special suction means are provided in order to clean the lower section of the painting unit conveyor so that it returns in a clean condition to the upper level in order to receive the new products to be painted. Finally, special means are provided in order to clean and maintain the cleanliness of the painting chamber.

It is obvious how, as a result of the simple but ingenious combination of the principles described above, it is possible to obtain a method and an apparatus for the industrial painting of wood products or its by-products which are able to achieve the following advantages:

- the products do not require preparative operations;
- the products may be loaded and unloaded automatically into and from the

painting plant;

- the products may be painted only on the visible surfaces, as is required for certain applications, for example the construction of furniture, skirting boards and profiled parts;

5       - the paint of the products has an excellent finish;

- there is no wastage of painting material;

- the surplus paint which remains in the painting chamber and which remains on the conveyor belt may be easily recovered and immediately recycled in its entirety.

10       Further characteristic features of the invention and the advantages arising therefrom will emerge more clearly from the following description of an embodiment illustrated by way of a non-limiting example in the figures of the attached sheet of drawings, in which:

- Fig. 1 illustrates schematically a perspective view of a painting unit according to the invention;

- Fig. 2 illustrates a partially sectioned side view of the painting unit according to Figure 1, operationally connected to the means for supplying the products to be painted and to the paint-hardening oven.

20       In the figures, 1 denotes a horizontal belt or band conveyor driven at its ends on horizontal and parallel rollers 2, 102, at least one of which is connected to driving means, not shown, which drive the upper section of this device for example in the direction indicated by the arrow F, for example with a continuous movement. The conveyor belt 1 is made with an electrically conductive material, for example an electrically conductive elastomer. The upper section of the conveyor 1 rests with its  
25       bottom side on a metal surface 3 or on equivalent means, such as metal rollers for example, which secure the said section in a flat and horizontal position and which keep it at a predefined electrical potential, for example at zero potential owing to the connection to earth, as indicated by 4.

30       At least the upper section 101 of the conveyor 1 passes, under optimum sealing conditions, through a chamber 5 provided at the opposite entry and exit ends

of the said conveyor with openings 6, 6' which are wide enough to allow the products to be painted to pass through freely. The chamber 5 is made, for example, using electrically insulating material so as not to attract the powdered paint and has a form suitable for easy periodic cleaning of the internal surface using automatic or manual means, not shown. According to another embodiment, the chamber 5 may be designed so as to assume, at least with its internal surface, an electric potential able to repel the powdered paints. Finally, the chamber 5 is connected to suction means which are schematically indicated by 7, 7' and which keep said chamber internally under a slight vacuum with respect to the external environment so that traces of powdered paint are unable to escape from the entry and exit openings 6, 6'. The suction means 7, 7' are connected to means, not shown, for recovery of the sucked-up powdered paints.

8, 8' indicate profiled parts which preferably cover, over a portion of suitable width, the edges of the upper section 101 of the conveyor 1 so that the latter are not affected by the powdered paints and so that the said conveyor may then be more easily cleaned, as usually is envisaged in horizontal painting machines using liquid paints.

The products P to be painted are fed automatically onto the upper section of the conveyor 1 by a feed conveyor 9. Before entering the painting chamber 5, it is preferably envisaged that the shape and size of the said products are detected by an opto-electronic unit 10 of the known type, which controls operation of the painting means located inside the chamber 5. Inside this chamber, bars 11, 11' for spraying the powdered paints are in fact located after the entry opening 6 and before the exit opening 6', with the possibility of adjustment of the distance from the conveyor 1 and transversely with respect to the said conveyor, said bars being directed so as to be able to spray uniformly also the vertical or inclined walls of the products P, whether they be directed transversely or parallel to the direction of travel of the said products. The bars 11, 11' may be made to perform an alternating movement transverse to the direction of travel of the products P, as indicated by the arrows F11.

It is understood that, depending on the shape of the products to be painted,

the paint-spraying means may be more than two in number and may be located with a suitable inclination also along the side of the travel path of the said products, all of which in a way which is obvious to and may be easily realized by persons skilled in the art. The paint-spraying means will be controlled by the opto-electronic unit 10  
5 which will activate them when the product P passes by and may also control modification of the direction and/or position thereof, in relation to the shape of the said product.

The paint-spraying bars 11, 11' are connected to distribution devices 12, 12' located outside the chamber 5 and in turn connected to the unit 13 supplying and  
10 electrostatically charging the powdered paint to a potential such that the said powder may be attracted by the upper section of the conveyor 1 and by the products P which rest on the latter and which pass through the chamber 5.

As they pass through the chamber 5, the products P are uniformly lined with powdered paint on their visible surfaces, while their bottom surfaces remain clean. It  
15 is for this reason that, immediately after the product lined with powdered paint has left the conveyor 1, the lower section 201 of the said conveyor is cleaned by first cleaning means 14, for example operating by means of scraping and suction. Further optional cleaning means 14' may also be provided at the other end of the lower section 201 of the conveyor 1, so as to ensure that the said conveyor is  
20 completely clean when the upper level receives the products to be painted from the feed conveyor 9.

The products P lined with the layer of paint then pass onto a conveyor 15 which conveys them into the oven 16 containing preferably first operating means (not shown), emitting IR radiation at a temperature and for a duration such as to cause  
25 plasticization of the powdered paint and at the same time such as not to deform the painted product, as well as second operating means (not shown) for emitting UV (ultraviolet) radiation for ensuring catalysis and hardening of the paint. The final stage of the oven 16 also comprises special means, also not shown, for cooling the painted products.

30 Before entering the oven 16, for example during transfer from the conveyor 1

to the conveyor 15, special means 17, for example of the rotating roller type, may be provided in order to clean the bottom side of the products P and remove any traces of powdered paint.



CLAIMS

1) Method for the horizontal painting of mainly flat wood products or wood by-products, characterized by the succession of following working steps:

5       - optional surface treatment of the products in order to make them electrically conductive;

      - placing the products on a horizontal conveying surface by means of which the said products are brought to a predefined electric potential, for example zero potential, with connection to earth; the products are then placed on the horizontal conveying surface so as to be protected against painting on the side directed  
10       towards the said conveying surface;

      - spraying the visible surface of the products with a powdered paint supplied with spraying systems which electrostatically charge it to a potential such that the said paint is deposited uniformly and remains attracted over the whole visible surface of the product;

15       - plasticization and catalysis of the powdered paint by means of IR and/or UV radiation treatment and final cooling.

2) Method according to Claim 1, characterized in that it comprises an optional step involving cleaning of the bottom surface of the products after the step involving paint-spraying, in order to remove any traces of powdered paint before the  
20       said products undergo the final step involving hardening by means of IR and/or UV-ray treatment.

3) Method according to the preceding claims, in which the final IR-ray treatment is performed at a temperature and for a duration such as to avoid physical deformation of the painted products.

25       4) Apparatus for the horizontal painting of mainly flat wood products or wood by-products, in particular for implementing the method according to the preceding claims, characterized in that it comprises:

      - a horizontal conveyor (1) which is made of electrically conductive material and which, with its upper section (101), travels continuously in one direction (F) and  
30       on the front end of which the products (P) to be painted are deposited;

- means for bringing the said conveyor (1), or at least the upper section thereof, to a predefined electric potential; for example zero potential with connection to earth;

5       - a chamber (5) closed at the bottom by an intermediate portion of the upper section (101) of the said conveyor (1) and provided at its opposite ends with entry and exit openings (6, 6') for the products yet to be painted and products already painted;

10       - means (7,7') for sucking air from the said painting chamber (5) in order to prevent the escape of particles of powdered paint from the openings (6, 6') thereof and from the conveyor connection zones;

15       - spraying means (11, 11') located inside the said chamber and connected to complementary external means (12, 12', 13), for spraying onto the visible surface of the products passing inside the said chamber a powdered paint electrostatically charged to a potential such that it may be uniformly attracted by the visible surface of the said products (P);

      - means (14, 14') for removing from the lower section (201) of the said conveyor (1) the powdered paint which is supplied by the said spraying means (11, 11') and which has not struck the products to be painted;

20       - a conveyor (15) which collects the products leaving the conveyor (1) of the painting unit and introduces them into an oven (16) for plasticization and hardening of the paint with IR and/or UV radiation.

25       5)     Apparatus according to Claim 4, in which the spraying means (11, 11') which spray the powdered paint onto the products (P) which pass inside the painting chamber (5) are made to perform a movement (F11) such as to ensure uniform dispersion of the paint supplied onto the said products.

30       6)     Apparatus according to the preceding claims, in which opto-electronic means (10) are provided upstream of the painting chamber (5) in order to detect the dimensions and shape of the products to be painted and control activation, deactivation and if necessary also the movement of the means (11, 11') for spraying the powdered paint.

7) Apparatus according to the preceding claims, characterized in that the conveyor (1) on which the products to be painted rest is made with an electrically conductive elastomer and its upper section (101) rests on a fixed electrically conductive surface (3) connected to earth (4).

5 8) Apparatus according to the preceding claims, in which special protective elements (8, 8') are provided in order to cover the longitudinal edges of the upper section (101) of the conveyor (1) which passes inside the painting chamber (5), in order to prevent the powdered paint being deposited on said edges and facilitate the following step involving cleaning of the lower section of the said  
10 conveyor.

9) Apparatus according to the preceding claims, in which the painting chamber (5) is made with a material and/or using techniques such as to prevent the deposition of powdered paint thereon.

10) Apparatus according to the preceding claims, characterized in that it  
15 comprises means for periodic cleaning of the internal surfaces of the painting chamber (5).

11) Apparatus according to the preceding claims, characterized in that it comprises means (17) for cleaning the bottom surface of the products leaving the conveyor (1) of the painting unit, so as to remove any traces of powdered paint  
20 before transfer of the said products into the paint-hardening oven (16).



## INTERNATIONAL SEARCH REPORT

Inter al Application No

PCT/EP 00/08740

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 7 B05B13/02

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 901 666 A (KUMADA, MITSUYOSHI ET AL) 20 February 1990 (1990-02-20) column 4, line 20 -column 6, line 47; figure 6	1,3-5,9
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☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

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\*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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Date of the actual completion of the international search

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European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Innecken, A

## INTERNATIONAL SEARCH REPORT

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## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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